The Effect Of Media Use Behavior On The Preference For Smartphone Specifications

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Abstract
The paper aims to analyze the effect of media use behavior of cellphone users on the preferences for cellphone specifications. Based on the survey data of the Korean Information Society Development Institute and data on hardware attributes of mobile phone models, we employed a mixed logit model for the estimation of the interactions between consumer attributes and product characteristics. Since cellphone producers are sensitive to cellphone customers' preferences for hardware specifications, this study's results can provide a clue to predict technological changes on cellphone hardware.

Keywords: Smartphone Specifications, media use behaviour

Introduction
The paper aims to analyze the effect of media use behavior of cellphone users on the preferences for cellphone specifications. Under the assumption that cellphone producers are sensitive to cellphone customers' preferences for hardware specifications, this study's results can provide a clue to predict technological changes on cellphone hardware.

The cellphone, especially the smartphone, has a lot of functions for media contents, so that cellphones as a new media device have substituted the traditional media devices such as the radio or the television. As new applications and media contents that can be used with a cellphone are having been developed steadily, the frequency and the use time of media contents by cellphone have increased. In fact, the average daily internet use time by mobile devices is 103.8 minute in 2014, which is a 20.4 minute increase from the 2013 record[86]. The average daily smartphone application use time

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[86] Korea Internet & Security Agency(KISA), 'Investigation Report on Internet Using Condition in 2014' source: http://isis.kisa.or.kr/board/?pageId=060100&bbsId=7&itemId=809&pageIndex=1

in 2015 is 143 minute, which is more than the daily meal time, while the use time for game, music and video contents is 52 minute[87].

In the paper, we combined the two data sets of the survey data (the *Korean Media Panel Survey* conducted by KISDI in July 2013) on cellphone users and the information on hardware specifications of the cellphone models. The survey asked the respondent's media contents use behavior, social economic status, and the cellphone brand that she used. From the given cellphone brand information, we presumed the specific cellphone model and gathered hardware specification information from online auction sites. With the combined data set, we employ the mixed logit model for an empirical analysis.

The paper proceeds as follows. In section II, we provide the literature review. Next, we describe our estimation model with data and variables in section III. In section IV, we discuss the estimation results and their implications. In section V, we summarize the results and conclude.

Literature Review

When companies consider the market segment which they want to target, it is necessary to investigate potential customer's needs that are strongly connected to their life styles. Already many studies have mentioned life style as tool to make the market segment, saying that life style provides a rich view of the market as a portrait of consumers (Ahmad, Omar, & Ramayah, 2010; Liu, Chang, & Lin, 2012; Rahman, 2011; Vyncke, 2002)

Prior research that investigates the product attributes is based on the laddering approach of Reynolds and Gutman (1988) that sees products as embodying a vector of characteristics (Zhu, Wang, Yan, & Wu, 2009). The ladder consists of the vector of product's characteristics on an ascending scale. However it is commonly acknowledged that consumers are heterogeneous in preferences, meaning the different satisfactions of different consumers with the same product attribute. Some studies have tried to find the link personal attributes, like lifestyle, to preferences on the product attributes (Haught, Wei, Xuerui, & Zhang, 2014; M. Haverila, Rod, & Ashill, 2013; M. J. Haverila, 2013; Mishra, 2015; Zhu et al., 2009)

Some of these prior studies have focused on a mobile phone or mobile phone use behavior. It is thought that with fast technological developments, mobile phone has become the necessity of our daily life. For example, Zhu et al. (2009) classified four consumer attributes about their preferences on fashion, such as shopping, price consciousness, habitual consumption conscious, and quality consciousness. Then they empirically analyzed the relationship of consumer attributes with mobile phone charging

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[87] http://news.chosun.com/site/data/html_dir/2015/09/22/2015092202493.html

attributes. Hamka, Bouwman, De Reuver, and Kroesen (2014) made clusters considering customers' lifestyle characteristic such as yuppies, socially concerned type, career-makers, and traditionalists. Using latent class analysis, they found that these segmentations are related to mobile service usage behavior including the usage of network and the usage of content services. Using demographic variables instead of lifestyle variables, Hong, Thong, Moon, and Tam (2008) and Peslak, Shannon, and Ceccucci (2011) found that demographic attributes are related to mobile phone usage behavior. When mobile phone functions and services were relatively simple, Kim, Lee, and Koh (2005) investigated the possible direction of device convergence through consumer preferences for product attributes, and they found that consumers generally prefer a keyboard and medium-size display while consumers are indifferent to the internet service quality and to the capability for operating many application.

Studies that focused on the mobile phone usage behavior may assume that mobile phone features are so similar that they are not necessary to consider. However people typically select their mobile phones after comparing specific features among several models. As smartphone users proliferate and the smartphone becomes an important device for consuming media services, several studies address the effect of smartphone usage on the other media use. In this paper, we direct attention to the possibility that customers' media behavior does have significant influences on the preferences over smartphone attributes.

Research design and data

This study estimates the demand function for mobile phones, using data of individual customer's attributes and mobile phone attributes. From the estimated demand function, it is possible to find out how individual attributes like a mobile phone usage behavior have influences on the preferences for main attributes of mobile phones.

For this purpose, we use a discrete choice model called the mixed logit model. It is acknowledged that the mixed logit model is flexible to obviate the limitations of the conditional logit model by allowing for random taste variation and unrestricted substitution patterns (Ben-Akiva, Bolduc, & Walker, 2001; McFadden & Train, 2000).

We define consumer i's utility function for alternative (mobile phone model) j as follows:

$$U_{ij} = \delta_j + \sum_k \sum_{r=1}^{R} x_{jk} z_{ir} r_{kr} + d_j v_i r^u + \epsilon_{ij}, \qquad \cdots \quad (1)$$

where δ_j is the mean utility level from choosing alternative j while the other terms of right-hand side indicate the utility unique to individual i received by

choosing alternative j. The second term represents interactions between the observed consumer i's attribute and the observed attributes of the alternative j where x_{jk} is the κ th observable attribute of mobile phone model j and z_{ir} is a consumer i's rth observable attribute, and r_{kr} means the coefficient of the interaction term. In the third term, v_i indicates the consumer i's unobservable attribute that affects the utility level of alternative j while d_j is the dummy variable for alternative j. r^u is the coefficient of the third term. In the mixed logit model, it is assumed that v_i is IID (independent and identically distributed) by the standard normal distribution. Lastly, ϵ_{ij} denotes consumer i's idiosyncratic tastes for alternative j and it is IID by the type I extreme value distribution.

With the assumption that v_i and ϵ_{ij} are stochastically independent, the conditional probability that consumer i selects alternative j is:

$$P_r(y_i = j | x, \xi, z_i)$$
$$= \int_v \frac{\exp(\delta_j + \sum_k \sum_{r=1}^R x_{jk} z_{ir} r_{kr} + d_j v_i r^u)}{1 + \sum_d \exp(\delta_d + \sum_k \sum_{r=1}^R x_{dk} z_{ir} r_{kr} + d_d v_i r^u)} P_0(dv) \quad \cdots \quad (2)$$

In equation (2), $y_i = j$ indicates that consumer i select alternative j, and $P_o(dv)$ is the probability distribution function of $v = (v_1, \cdots, v_n)'$ where n is the number of consumers. In this study, we conducted a simulated maximum likelihood estimation to obtain the estimates of r_{kr} as well as δ_j.

There are two data sets of user attributes and product characteristics. Data on consumer attributes come from the Korean Media Panel Survey conducted by Korean Information Society Development Institute (KISDI) in 2013. Respondents of the survey were required to recode their media use in a diary, called *the media diary*, which includes place, time, contents, and devices to use media contents. Respondents can recode their behavior by selecting one among the given 38 behavior examples which we reclassified into the 4 groups such as video-image contents usage, traditional communications usage, chatting, and SNS or /information searching[88].

As the individual demographic information, we use age, gender, and whether having a job. The age variable is a dummy variable: 1 for the person over 50s and 0 for the others. The relatively young generation less than 50 year old would be familiar with adopting new technologies and with replacing the old phone with the latest one. Gender is acknowledged as a significant variable that influences the mobile phone usage.

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[88] 'Video-Image contents usage' includes specific behavior as follows: watching TV programs, a movie, UCC contents, and pictures. 'Traditional communications usage' means talking on the phone and sending a text message. 'Chatting' indicates behavior such as using e-mail services and chatting through online chat applications. 'SNS or information searching' includes behavior such as using social network services and searching information through the internet, and using an e-commerce services.

The second data set is on the attributes of mobile phone models. Some questions of the Korean Media Panel Survey are about the respondent's mobile phone model name and the year that the respondent purchased the mobile phone. However the reported model names are too rough to recognize the accurate model, so that we choose the specific mobile phone model by assuming that people want to buy the latest model. Under the information of the mobile phone's model name and the purchased year that the respondent reported, we searched the latest model and its specific attributes from the e-commerce websites[89] that provide hardware attributes of all the released mobile phone models. If there are the several latest models for the same brand and the same released year, we chose the best seller according to the mobile phone's sales record that the e-commerce websites provided. Finally 13 models are used in this study as follows:

Table 1: The mobile phone models

Num.	Manufacturer_Brand	Model	Model Num.	Frequency	Share (%)
1	Samsung_Galaxy S	Galaxy S4LTE	SHV-E300K	711	40.19
2	Samsung_Galaxy Note	Galaxy Note3	SM-N900S	395	22.33
3	Samsung_Galaxy	Galaxy Win	SHV-E500S	58	3.28
4	Samsung_Omnia	Ozomnia	SPH-M7350	14	0.79
5	Samsung	Minimal Folder	SHW-A301S	94	5.31
6	LG_Optimus	G2	LG-F320S	279	15.77
7	LG	WineSherbet	LG-SH840	43	2.43
8	Apple_iPhone3	iPhone3Gs	iPhone3Gs	5	0.28
9	Apple_iPhone4	iPhone4s	iPhone4s	13	0.73
10	Motorola	MotoG	XT1032	3	0.17
11	Apple_iPhone5	iPhone5s	iPhone5s	42	2.37
12	PenTech_Vega series	Vega Secret Up	IM-A900S	103	5.82
13	PenTech_Sky Series	Dupont folder	IM-U700S	9	0.51
Total				1,769	100.00

After collecting product attributes information for the 12 models, we selected the important attributes that would have some influences on customer's choices. We visited the mobile phone stores and investigated attributes that customers asked frequently. From the interviews with five mobile phone sellers, we found seven attributes which are commonly mentioned by the sellers such as whether it is a smartphone or not, the display size, the number of pixel of the mobile phone camera, the battery capacity, the weight, the storage capacity, and the price. Among these attributes, the display size is correlated with the battery capacity and the weight. And the price information has a problem to use in this study because

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[89] www.enuri.com / www.danawa.com

of subsidies that a seller provides for the purpose of sales promotion. Such subsidies may distort the market price of mobile phones and make a difference between the official price and the real price in markets. Hence, among diverse attributes, we selected four such as whether it is a smartphone or not, the display size, the camera pixel, and the storage capacity. The attributes of each mobile phone model is as follows:

Table 2: The hardware attributes of the selected mobile phone models

Num.	Model Name	Manufacturer	Smartphone	Released Year	Display Size(Inch)	Camera Pixel	Storage capacity (Gbyte)
1	Galaxy S4LTE	Samsung	Yes	2013	5	1300	32
2	Galaxy Note3	Samsung	Yes	2013	5.7	1300	32
3	Galaxy Win	Samsung	Yes	2013	4.66	500	8
4	Minimal Folder A301	Samsung	No	2013	2.6	200	0.082
5	G2	LG	Yes	2013	5.2	1300	32
6	WineSherbet	LG	No	2012	3	200	0.03
7	MotoG	Motorola	Yes	2013	4.5	500	8
8	iPhone5s	Apple	Yes	2013	4	800	16
9	Vega Secret Up	PenTech	Yes	2013	5.6	1300	16
10	Ozomnia	Samsung	Yes	2010	3.7	500	8
11	iPhone3Gs	Apple	Yes	2010	3.5	300	16
12	iPhone4s	Apple	Yes	2011	3.5	800	16
13	Dupont folder	PenTech	No	2010	3	300	0.08

Table 3: Variables

category	Number	Variable name	Variable definition and measurement	
Consumer attributes	1	video	the ratio of a mobile phone usage time to enjoy video-image contents	
	2	call/text	The ratio of a mobile phone usage time to call or to text message	
	3	chatting	the ratio of a mobile phone usage time to chat through mobile applications	
	4	sns	the ratio of a mobile phone usage time to use SNS or on-line searching	
	5	age	the over 50s and the others	1: the over 50s 0: the others
	6	gender	gender(female)	1: female 0: male
	7	job	whether a job retention	1: unemployed 0: employed
Product attributes	1	display	the size of display of the mobile phone	the diagonal length of a mobile phone display
	2	pixel	the number for camera pixel	
	3	storage	the storage capacity	Gbyte

Table 4: Summary statistics on mobile phone attributes

Category	variable	Measurement	num.	mean	standard deviation	minimum	maximum
non smartphone	display	Inch	3	2.867	0.231	2.6	3
	pixel	Million		2.333	0.578	2	3
	storage capacity	Gbyte		0.064	0.029	0.03	0.082
smart phone	display	Inch	10	4.536	0.836	3.5	5.7
	pixel	million		8.6	4.061	3	13
	storage capacity	Gbyte		20	10.832	8	32

Table 5: Summary statistics on mobile phone usage attributes

variable	scale	observation	mean(ratio)	standard deviation	minimum	maximum
video	Min./day	1769	4.664(6.23%)	11.391	0	195
call/text	Min./day	1769	31.492(42.11%)	33.989	0	490
chat	Min./day	1769	18.324(24.50%)	29.248	0	315
sns	Min./day	1769	2.524(3.37%)	13.784	0	385
total_time	Min./day	1769	74.771	63.778	0	745

Result

The estimation results of the mixed logit model in (1) are given in table 6.

Table 6: Estimation results

Independent Variable			Estimate	Standard error	t-value
alternatives	Samsung Galaxy S Series (GalaxyS4LTE)		-18.762	13.698	-1.373
	Samsung Galaxy Note (Galaxy Note 3)		-77.218	48.174	-1.611
	Samsung Galaxy (Galaxy Win)		-52.136*	28.033	-1.860
	Samsung Omnia series (OZomnia)		-25.187*	14.374	-1.750
	LG Optimus(G2)		-30.782	18.872	-1.632
	Apple-iPhone3		-48.306**	24.113	-2.001
	Apple-iPhone4		-20.739	13.467	-1.541
	Motorola-Moto G		-57.821*	31.862	-1.813
	Apple-iPhone5		-64.464	41.475	-1.554
	PenTech Vega Series (Vega Secret Up)		-23.067*	13.998	-1.653
Interaction terms	video	display	-0.031	0.054	-0.576
		pixel	0.015	0.011	1.333
		storage	-0.002	0.002	-0.946
	call/text	display	0.049***	0.017	2.827
		pixel	-0.006*	0.003	-1.786
		storage	0.002***	0.001	2.927
	chat	display	-0.012	0.014	-0.827
		pixel	0.0069**	0.003	2.026

		storage	-0.001	0.001	-1.583
	sns	display	-0.008	0.034	-0.242
		pixel	0.002	0.008	0.183
		storage	-0.001	0.002	-0.611
	age(over 50s)	display	5.053**	2.219	2.281
		pixel	-1.047***	0.385	-2.723
		storage	0.222**	0.093	2.481
	gender(female)	display	1.241	0.803	1.542
		pixel	-0.212	0.182	-1.167
		storage	0.009	0.041	0.232
	the unemployed	display	4.955***	1.151	4.311
		pixel	-0.971***	0.237	-4.174
		storage	0.200***	0.052	3.812
	unobservable individual attributes	Samsung Galaxy S Series (GalaxyS4LTE)	1.596	1.028	1.557
		Samsung Galaxy Note (Galaxy Note 3)	70.397	47.368	1.493
		Samsung Galaxy (Galaxy Win)	-12.129*	6.203	-1.965
		Samsung Omnia series (OZ omnia)	-2.328	1.435	-1.621
		LG Optimus(G2)	12.515*	7.501	1.676
		Apple-iPhone3	7.823	5.738	1.365
		Apple-iPhone4	0.106	1.499	0.072
		Motorola-Moto G	-10.084	6.538	-1.544
		Apple-iPhone5	-27.998	18.523	-1.513
		PenTech Vega Series (Vega Secret Up)	1.776	1.392	1.282

Among the results of interaction terms, the mobile phone display size has significant interactions with variables of the age and the call/text usage time. It is possible that people over 50s using mobile phones for mainly traditional communications such as calling and texting would have strong preference for the large screen smartphones because of their weak visions and conveniences of typing.

However display size is not significant in the interactions with video-image contents usage by the mobile phone. It means that watching video-image contents such as movies or TV programs is not related to the preference for the large display size. There are some alternatives to the smartphone to enjoy the video-image contents, such as the tablet PC and the small size notebook. If a consume spends more time enjoying video-image contents and if the consumer is very sensitive to the quality of display, she

would prefer a device which has a special advantage in the display quality while she uses the mobile phone mainly for searching for the video-image contents.

The camera pixel indicates the quality of video-image contents. It turns out that as people spend more time using chatting services or email services, they would have more preference for a higher camera pixel. The function of chatting applications and email services is not limited to transfer text message but extended to include exchanges of pictures. On the other hand, people use mobile phones for the simple communications via calling or texting have lower preference for the camera pixel.

It is likely to think that heavy users of video-image contents would prefer more storage capacity. However, it did not turn out like that. As mentioned above, these users may have alternative devices for video-image contents. Rather, like the case of the display size attribute, the people who use their mobile phones to communicate by traditional ways showed the high preference for the storage capacity attribute. The storage of the smartphone is used to install the operating system and to upgrade. Although the latest smartphone models have large size storage, it is hard to say that it is enough for heavy smartphone users who may use secondary or alternative storage devices.

Other interesting results are about the gender. Prior studies have said that the gender is an important variable that has a significant influence on mobile phone usage. However we cannot find any significant result related to the gender variable.

Conclusion

In this paper, we analyzed whether the consumer's preference for smartphone characteristics is affected by individual attributes that include media usage behavior. The results show that some consumer attributes have significant influences on the preference for the smartphone attributes such as the display size, the camera pixel, and the storage capacity.

For this analysis, we used the survey data of the KISDI and then combined it with data on hardware attributes of mobile phone models. The 1,769 survey respondents who purchased the new mobile phones in 2013 are selected and their attributes about age, gender, and job status are gathered.

We employed a mixed logit model for the estimation of the interactions between consumer attributes and product characteristics. In the estimation, we assumed that the outside alternative is a non-smartphone. Our results imply that the relationship between the media use behavior and the smartphone attributes is not straightforward, depending on the media environment in digital convergence.

Despite the limitation of the cross-sectional data, the paper contributes to the existing literature as a first step to quantitatively analyze the way in which and the extent to which the consumer's media use behavior affects her preference for the smartphone specifications. With more data over a longer period of time, we will be able to fully analyze the interaction between consumers' media use behavior and the evolution of the smartphone industry.

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